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(56) Documents Cited
GB 1398776 A GB 1131032 A GB 1065358 A
US 5135091 A US 5072584 A

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(71) Applicant(s)
Automotive Products plc

(Incorporated in the United Kingdom)

Tachbrook Road, LEAMINGTON SPA, Warwickshire, CV31 3ER, United Kingdom

(72) Inventor(s)
David Anthony Harries

(74) Agent and/or Address for Service
Roger Morrall
Automotive Products plc, Tachbrook Road, LEAMINGTON SPA, Warwickshire, CV31 3ER, United Kingdom

(54) Hydraulic actuation system for vehicle clutches

(57) An actuation system particularly for the operation of a vehicle clutch in which a pump 10d supplies pressurised fluid to a slave cylinder 11 via a spool-type solenoid-operated fluid flow control valve 12. The spool 37 of the control valve occupies a rest position when there is no requirement to supply fluid to the slave cylinder. In the rest position of the spool fluid supplied by the pump is returned to a sump 10a to reduce hydraulic load and the cylinder 11 is connected with a reservoir 10a via flow path X. When the solenoid 12a is activated, the dumping flow Y is cut off and pressurised fluid is supplied to the cylinder 11 from an accumulator 10c which is charged by the pump 10b.

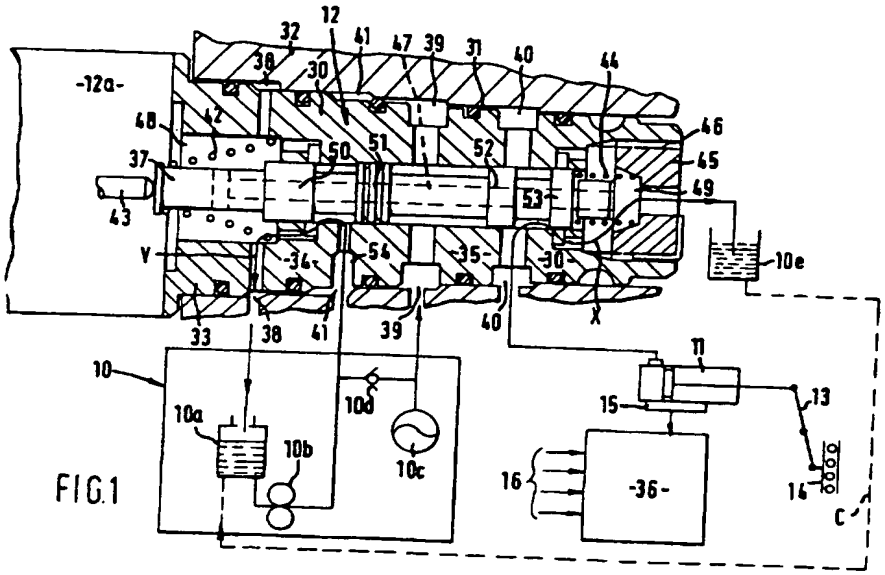

FIG.1

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1995

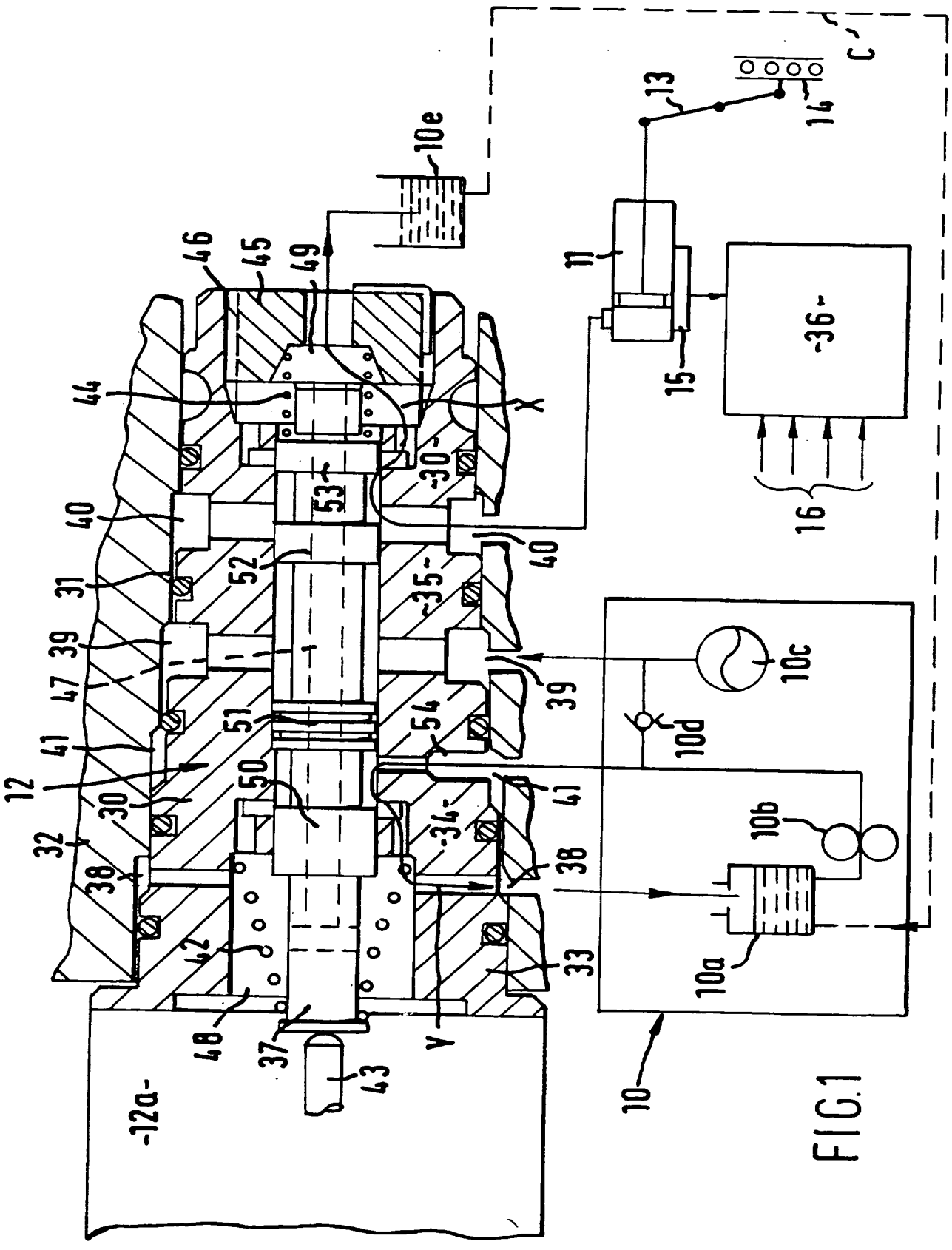

FIG.1

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ACTUATION SYSTEMS

This invention relates to actuation systems and in particular, though not exclusively, to such actuation systems for the operation of vehicle clutches used in semi-automatic transmissions of the form described in, for example the Applicants earlier European patents Nos. 0038113, 0043660, 0059035 and 0101220.

In such transmissions the engagement and disengagement of the clutch is controlled by an electronic unit in response to operation of the throttle and gear selector lever by the vehicle driver. Typically clutch engagement is monitored by sensing the position of a clutch release lever which operates the release bearing of the clutch. This is normally achieved by using a slave cylinder to operate the clutch release bearing which also includes a cylinder travel sensor.

It is an object of the present invention to provide an improved form of actuation system which is suitable for the above clutch operation.

Thus according to the present invention there is provided an actuation system comprising a pump which supplies pressurised fluid to a slave cylinder via solenoid-operated fluid flow control valve means, the solenoid-operated control valve means being arranged to return the pump output to sump when the solenoid is in a rest position and to cut-off the return to sump on initial movement of the valve means to supply

fluid to the slave cylinder.

The actuating system preferably also includes an accumulator which is charged from the pump and which supplies pressurised fluid to the slave via the control valve means. Preferably the accumulator is charged via a non-return valve.

Such a system has several advantages:-

1. When charging of the accumulator is completed the circuit on the pump side of the non-return valve can be arranged to be vented to sump thus reducing any tendency for that part of the circuit to leak under high pressure.

2. When the pump starts-up its output will be directed back to sump, thus it will not have to try to start against high back pressure in the system. This is particularly significant in low temperature environments where fluid viscosity is high and pumping losses can therefore be high also.

One embodiment of the present invention will now be described, by way of example only, with reference to the accompanying Figure 1 which shows details of a clutch actuation system in accordance with the present invention.

Referring to Figure 1 the clutch actuation system includes a hydraulic power pack 10 which operates a clutch operating slave cylinder 11 via solenoid operated fluid flow control valve 12. The power pack 10 includes a reservoir 10a, an electrically driven pump 10b, an accumulator 10c and a

non-return valve 10d. The slave cylinder 11 acts on a clutch actuating lever 13 which in turn acts on a clutch release bearing 14.

The displacement of clutch operating lever 13 is measured by a sensor 15, who's output is fed to an electronic control unit 36. Control unit 36 receives other vehicle operating parameter inputs designated 16 in Figure 1 and issues commands to solenoid 12a of the valve 12 to connect slave cylinder 11 to accumulator 10c or reservoir 10a. As indicated earlier, full constructional and operational details of electronic control unit 36 etc. can be found in the Applicant's previously referred to earlier patent applications and will not therefore be given here.

Returning now to the details of solenoid valve 12, this has an outer portion 30 which is inserted into a bore 31 in a housing 32 and is held stationary therein. The outer portion 30 includes lands 33,34,35 and 36 which are in sealing contact with bore 31 to define annular passages 38,39 and 40 which are connected with reservoir 10a, accumulator 10c and slave cylinder 11 respectively. A further passageway 41 is also defined around land 34 and is connected with pump 10b.

Within outer solenoid portion 30 is disposed an axially movable landed spool 37 which is acted on at one end by spring 42 and solenoid spindle 43 and at the other end by a spring 44 which reacts against a threaded nut 45 whose axial position within a threaded bore 46 of outer portion 30 enables the spring loading on spool 37 to be varied as described in the Applicants co-pending application No. 93 0839.7.

Spool 37 is provided with lands 50,51,52 and 53. With the spool 37 in the de-energised Figure 1 position slave cylinder 11 is connected with passageway 40 which is connected with reservoir 10e via flow path X. Also communication between accumulator 10c and slave unit 11 is cut off by land 52. Further, pump 10b is able to pump fluid from passageway 41 through passage 54 and around land 50 as indicated by flow path Y into chamber 38 and hence back into reservoir 10a. Thus with the solenoid 12a de-energised and the spool in the Figure 1 position the output of pump 10b is dumped back into reservoir 10a via flow path Y and any pressure in the feed to accumulator 10c on the pump side of non-return valve 10d is also dumped to reservoir 10a so that this connection is not under high pressure.

Reservoir 10e may be eliminated and flow path X routed to reservoir 10a via an additional passageway 47 (shown in dotted detail) down the centre of spool 37 which connects chambers 48 and 49 at the ends of the spool.

Alternatively, reservoir 10e could be eliminated and flow path X could be routed to reservoir 10a via external connection C shown in dotted detail in Figure 1.

As soon as the electronic control unit 36 determines that any action is required to operate slave cylinder 11 a command is issued to solenoid 12a to axially displace its spool 37 thus causing land 50 to cut off the pump dumping flow Y. Movement of land 52 to the right also opens a connection between accumulator 10c and slave cylinder 11 so that slave cylinder 11 can be pressurised as required.

As indicated previously, all movements of slave cylinder 11 are communicated to control unit 36 by sensor 15 so that the control loop is completed and accurate control of the position of clutch release lever 13 can be obtained.

When the level of pressure in accumulator 10c is above a predetermined minimum (sensed by an appropriate sensor which is in communication with control unit 36) the electrically driven pump 10b can be stopped and the solenoid spool 37 returned to the Figure 1 position when no pressurisation or depressurisation of slave 11 is currently required.

As will be appreciated, when the pump is restarted to recharge accumulator 10c solenoid spool 37 is in the Figure 1 position so that the pump output dumping circuit Y is established and the pump can therefore restart against a relatively low hydraulic load. This is particularly important in low temperature operating conditions when the viscosity of the oil being pumped may be considerable and impose a high starting load on the pump.

Also, the unloading of accumulator feed pressure on the pump side of non-return valve 10d when the accumulator is fully charged makes this system less susceptible to hydraulic leaks.

CLAIMS

1) An actuation system comprising a pump which supplies pressurised fluid to and exhaust fluid from a slave cylinder via solenoid-operated fluid flow control valve means, the solenoid-operated control valve means being arranged to return the pump output to sump when the solenoid is in a rest position and to cut-off the return to sump on initial movement of the valve means to supply fluid to or exhaust fluid from the slave cylinder.

2) A system according to claim 1 which includes an accumulator which is charged from the pump and which supplies pressurised fluid to the slave via the solenoid-operated control valve means.

3) A system according to claim 2 in which the accumulator is charged via a non-return valve.

4) A system according to claims 2 or 3 in which the pump is electrically driven and is stopped when the accumulator pressure is above a pre-determined level.

5) A system according to any one of claims 1 to 4 in which the solenoid-operated control valve means is a spool

valve with the flow of fluid to and from the slave cylinder controlled by the axial position of a spool with the initial axial movement of the spool from its rest position being arranged to cut-off the return flow of fluid to the sump.

6) A system according to claim 5 in which the spool includes an axially extending passage down which fluid can flow from the slave cylinder to the sump.

7) A system according to any one of claims 1 to 6 in which an electronic control means receives signals indicative of the operating condition of a component to be controlled by the slave cylinder, the electronic control means issuing signals to the solenoid-operated control valve means to supply fluid to or exhaust fluid from the slave cylinder in response to said operating condition signals.

8) A system according to any one of claims 1 to 7 in which the slave cylinder is connected with a vehicle clutch for the operation thereof.

9) An actuation system constructed and arranged substantially as hereinbefore described with reference to and as shown in the accompanying drawing.

The Patent Office

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Application No: GB 9420984.8
Claims searched: 1 to 9

Examiner: R C Squire
Date of search: 20 March 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): F2L (LT)

Int Cl (Ed.6): F16D; F15B; F16K

Other:

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 1398776	BOSCH (see page 1 lines 87 to 95)	1,8
X	GB 1131032	BUTTERFLY (see page 2 lines 53 to 58)	1,8
X	GB 1065358	HANS GLAS (see valve 5)	1,5,8
X	US 5135091	ALBERS (see valve 7)	1-4,8
X	US 5072584	MAUCH (see valve 24)	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.